Building NRCS Technical Capacity in Irrigation Water Management for Variable Rate Irrigation

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Conservation *Collaboration* Grant or Agreement

- NRCS invited NDSU to participate
  - Producers express interest in new technology
    - Through NRCS farm bill programs
  - Technologies related to irrigation
    - Sensors, telemetry, and software settings
    - Remote sensing products – VRI maps

Building NRCS Technical Capacity

- Better help for producers
  - EQIP & CSP program contracts
- Training for
  - Crop consultants
  - Irrigation dealers
  - Producers

Sponsors and Cooperators

- USDA-NRCS Sponsorship
  - Christi Fisher
    - USDA-NRCS ND State Conservation Engineer
  - Erica Althoff
    - USDA-NRCS Area Engineer
  - Jordaan Thompson-Larson
    - Resource Soil Scientist
- Cooperators
  - Sites 1, 2, & 3
- North Dakota Agricultural Experiment Station

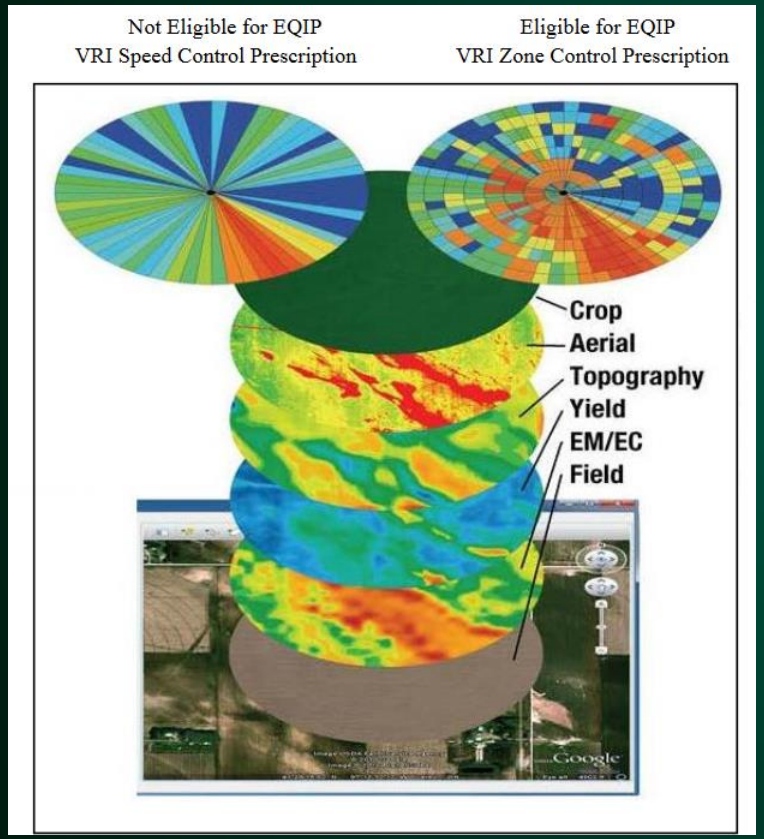
Research Team

- NDSU/ND Ag Expt Sta
  - Dean Steele
  - Tom Scherer
  - Xinhua Jia
  - Paulo Flores
  - Sheldon Tuscherer
  - Dongqing Lin
  - Mathew Blum
- University of Nebraska-Lincoln/Daugherty Water for Food Global Institute
  - Christopher Neale
  - Derek Heeren
  - Trenton Franz

Background

- NRCS-EQIP Supports Conversion to VRI
  - Advanced irrigation water management (IWM)
  - Soil moisture monitoring with telemetry
  - 3 years

NRCS EQIP for VRI



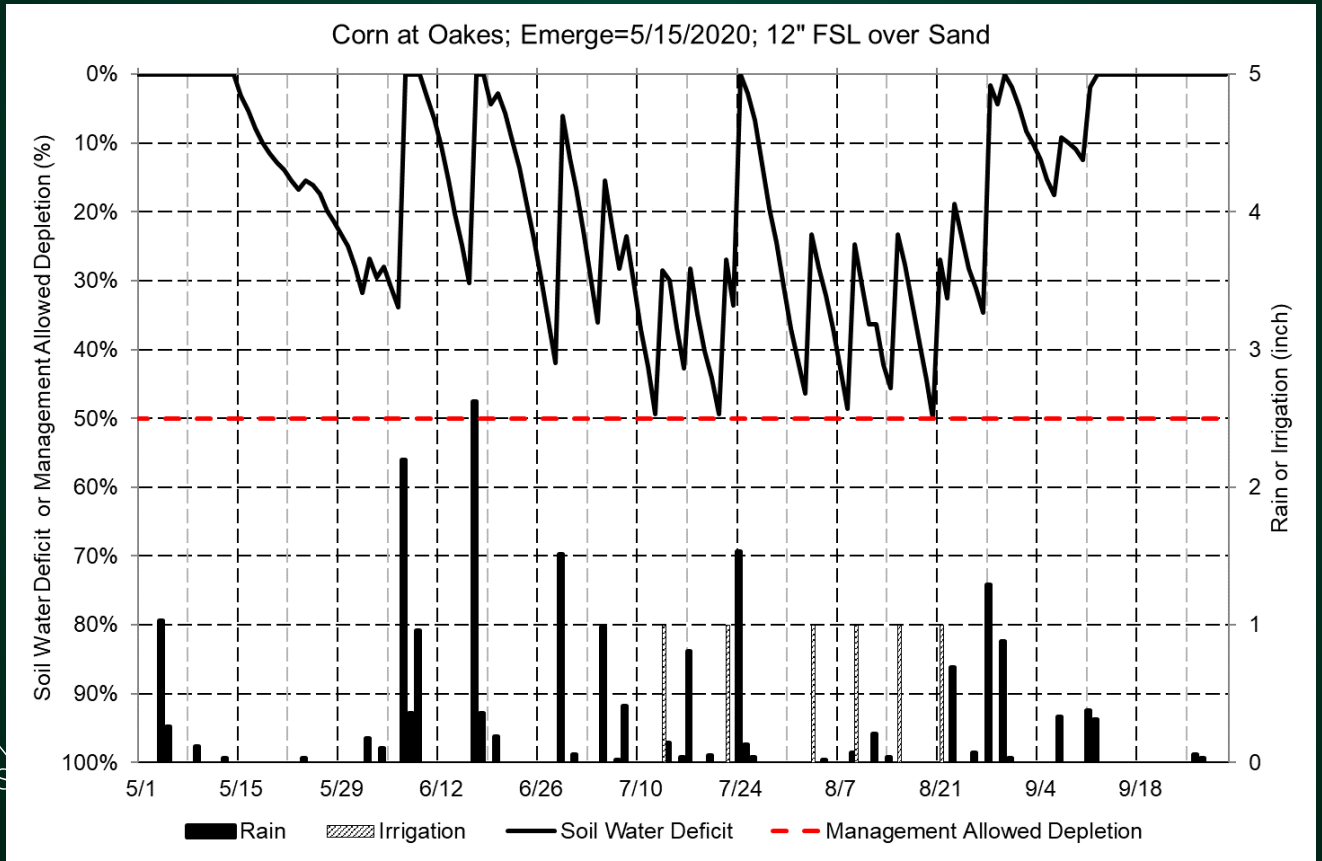
- Variable Rate Irrigation
  - None
  - Sector control
  - Zone control

- https://efotg.sc.egov.usda.gov/references/public/SC/Sprinkler_System_VRI-442_TSP_Checklist_SCIG_Supplement_2016.pdf
- See also https://www.ag.ndsu.edu/irrigation/documents/irrigation-workshop-2017/althoff-nrcs

Objectives

- Evaluate IWM services and technologies
  - Soil moisture sensors
  - Remote sensing imagery
- Evaluate VRI watering prescriptions
  - Research-grade VRI map
  - Commercial VRI maps

Scheduling by Water Balance



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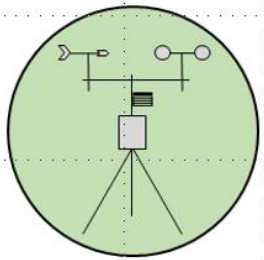
Farm of the Future Inputs

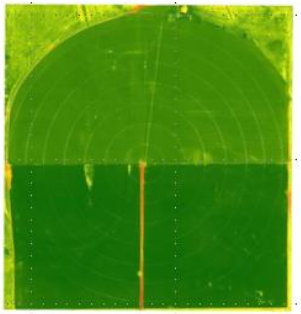
Spatial EvapoTranspiration Modeling Interface (SETMI)

Dynamic Inputs

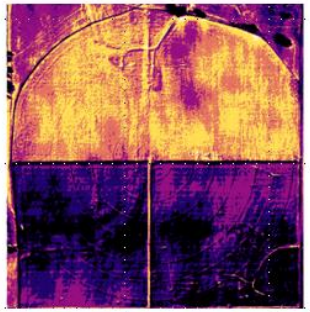
Weather Data



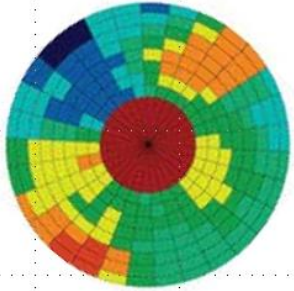
Multispectral Imagery



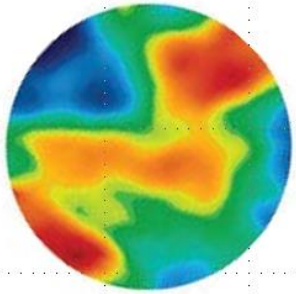
Thermal Imagery



Previous Irrigation Maps



Previous Modeled/Measured Soil Moisture Content

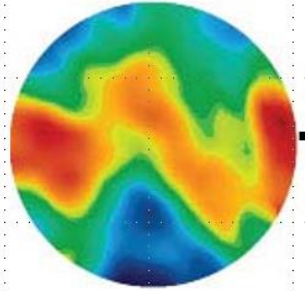


SETMI hybrid model

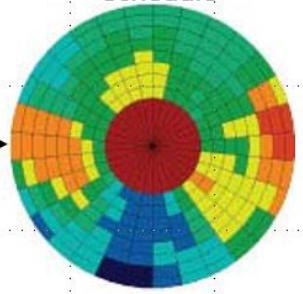
Reflectance based Crop Coefficient, Two Source Energy Balance, and Soil Water Balance models.

Outputs

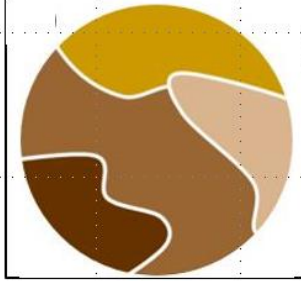
Current Modeled Soil Moisture Content



New Irrigation Prescription and Schedule



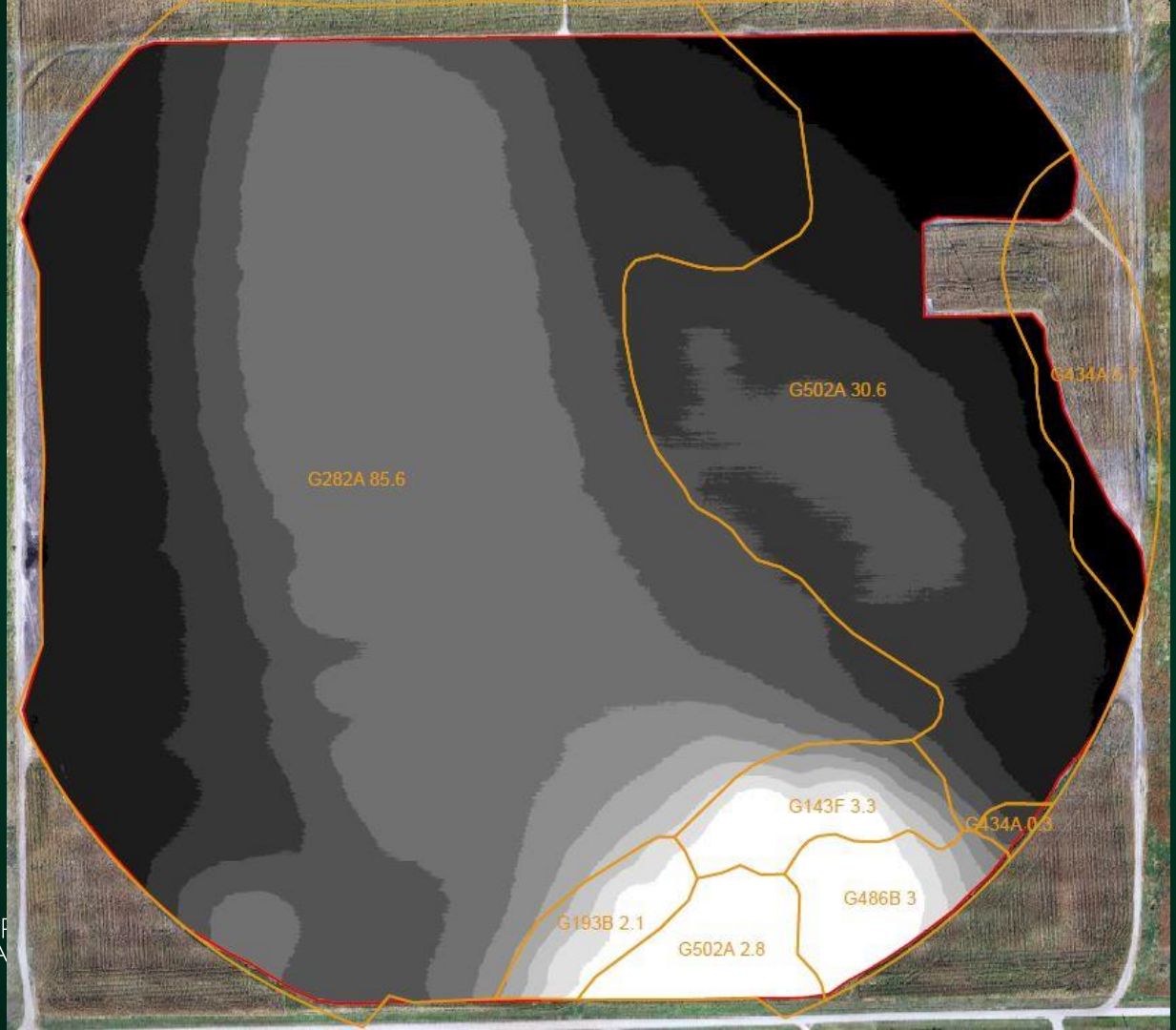
Static Inputs



Soil and Crop Type
Pivot Characteristics

Methods

- Geophysical surveys
- Soil sampling
- Sensors
- VRI prescription maps


G502A 30.6
G282A 85.6
G143F 3.3
G434A 0.3
G486B 3
G193B 2.1
G502A 2.8

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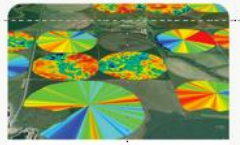
Examples of Geophysical Sensors in Use Today

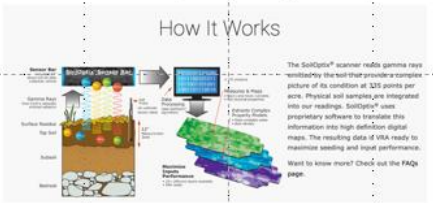
CropMetrics/CropX

Use Dualem to map soil electrical Conductivity to make prescription maps (water, planting, nitrogen)



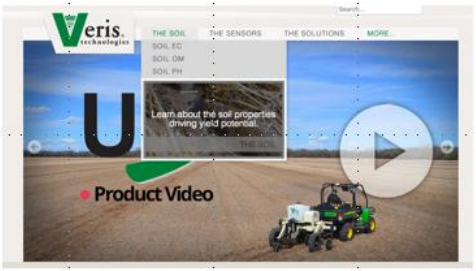
SoilOptix

Use gamma ray detector and soil cores to make soil physical and chemical property maps



Veris

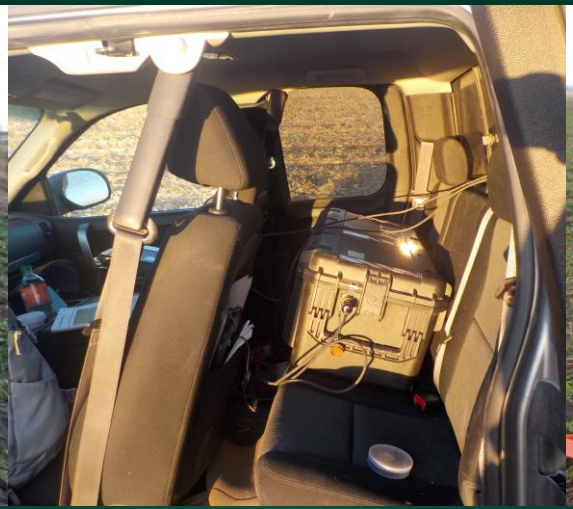
Use electrical resistivity and visible light to map soil physical and chemical properties



Slide courtesy of Trenton Franz

Photos taken from company websites. Other companies include Trimble and SmartFirmer

Cosmic Ray Neutron Probe



Gamma Detector

Electromagnetic Induction Sensor

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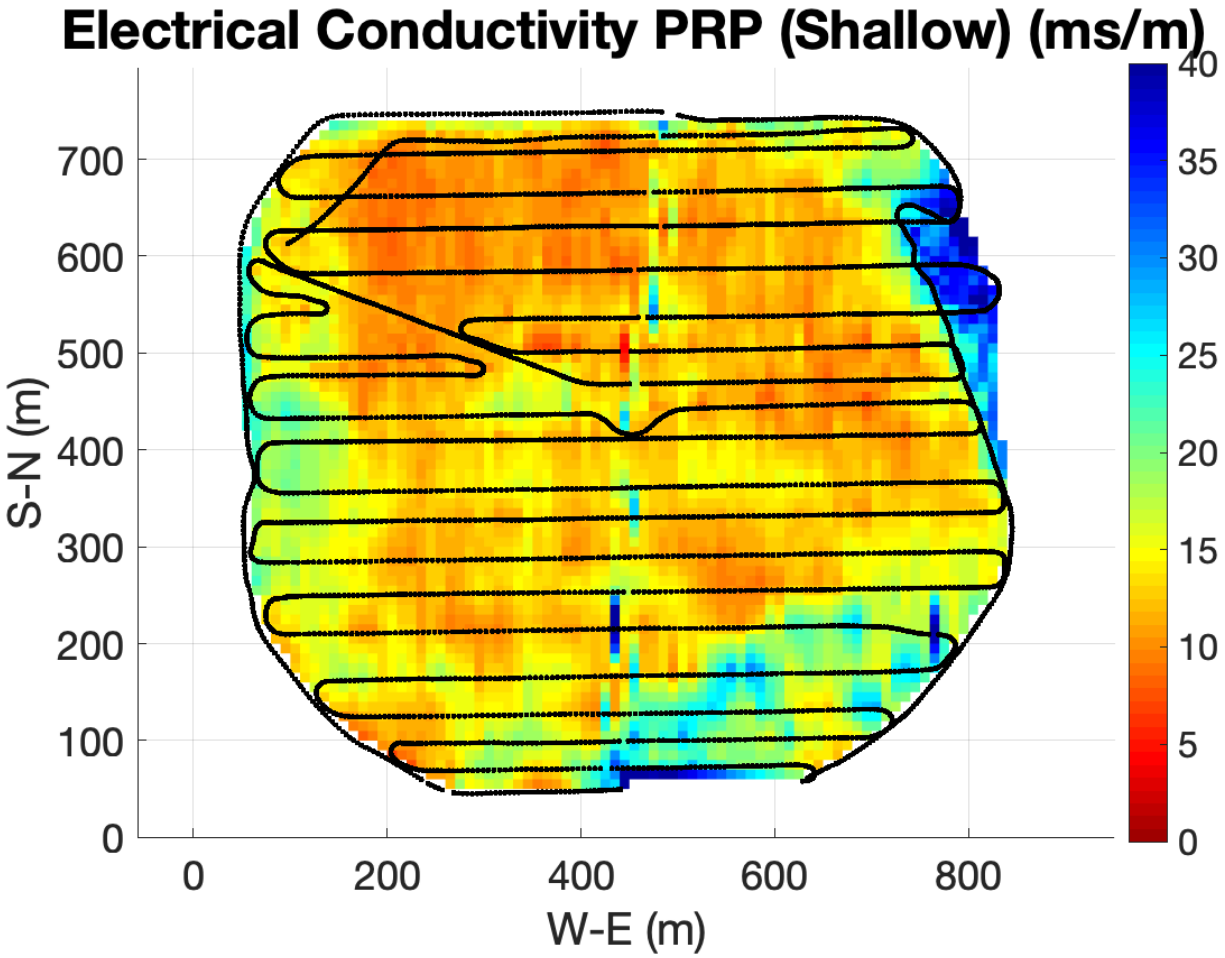
Electrical Conductivity PRP (Shallow) (ms/m)
S-N (m)
W-E (m)
0
100
200
300
400
500
600
700
0
200
400
600
800
0
5
10
15
20
25
30
35
40

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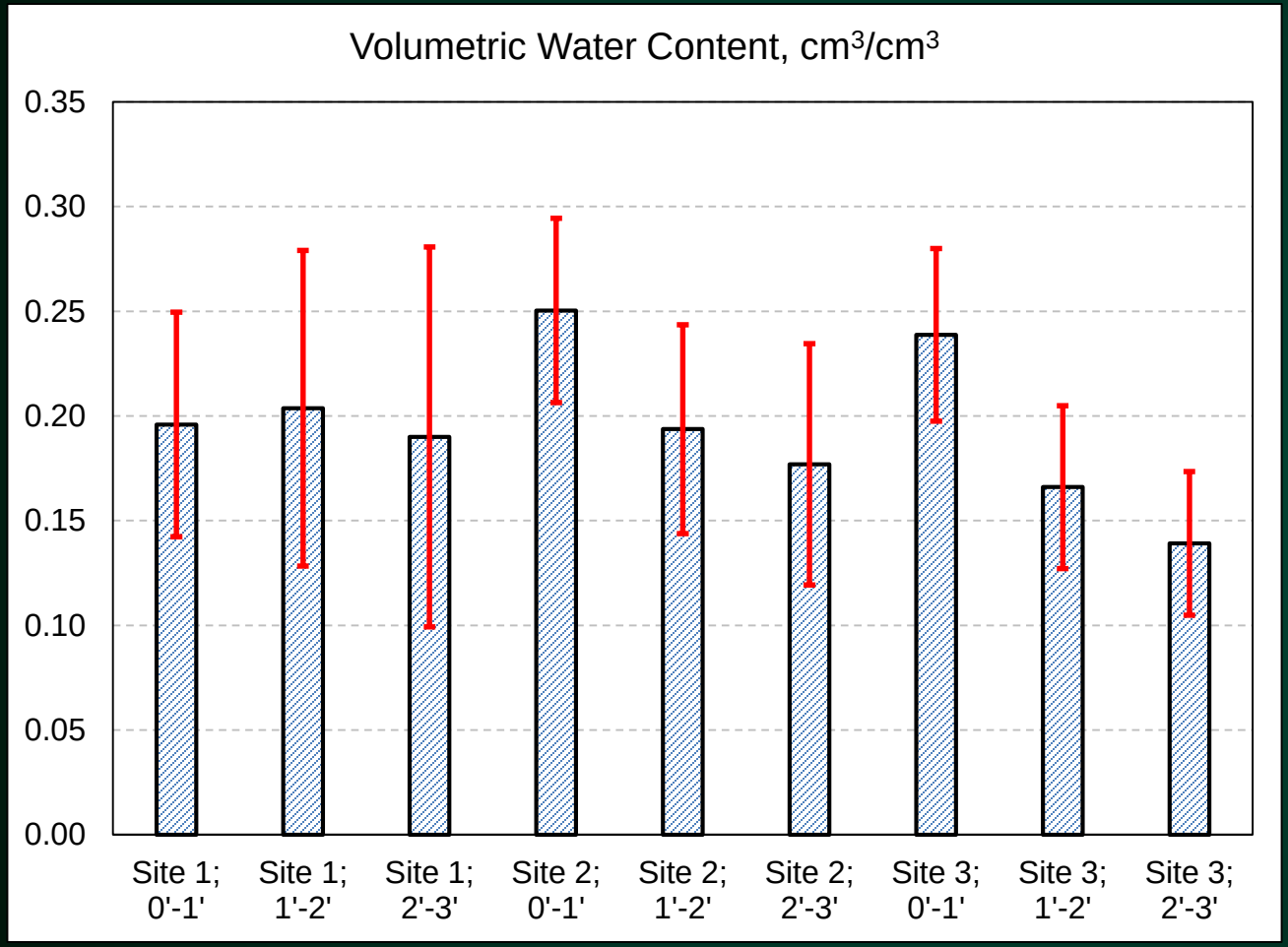
Soil sampling and sectioning

3 Fields x 15 Stations x 3 Depths = 135 Samples



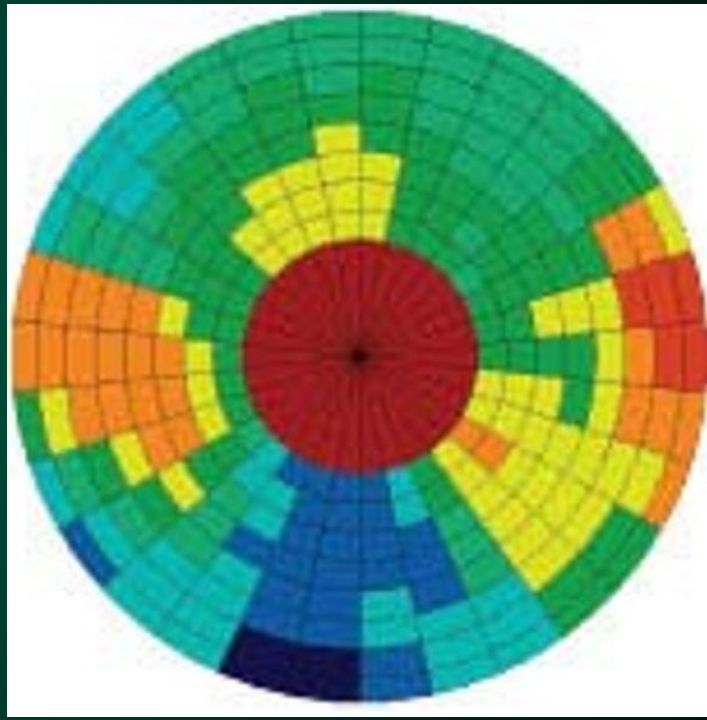
Also. . .
Bulk density
Field capacity
Permanent wilting point
Electrical conductivity
Cation exchange capacity
pH

Soil Water Sensors

- Acclima - TDR
- Reinke – CropX
- Farm QA – AquaSpy
- Lindsay – FieldNet
- Valley – Aqua Trac, Sentek

VRI Prescription Maps

- Reinke – CropX
- Lindsay – FieldNet
- Valley Scheduling Platform
- Ceres Imaging
- UNL - SETMI



Project Outcomes

- Training opportunities
  - Best practices
  - Tips
  - Techniques
- Sensor performance comparisons
- Prescription map comparisons

Training Opportunities

- Producers
- NRCS staff
- Irrigation dealers
- Crop consultants
- Agency personnel
- Students

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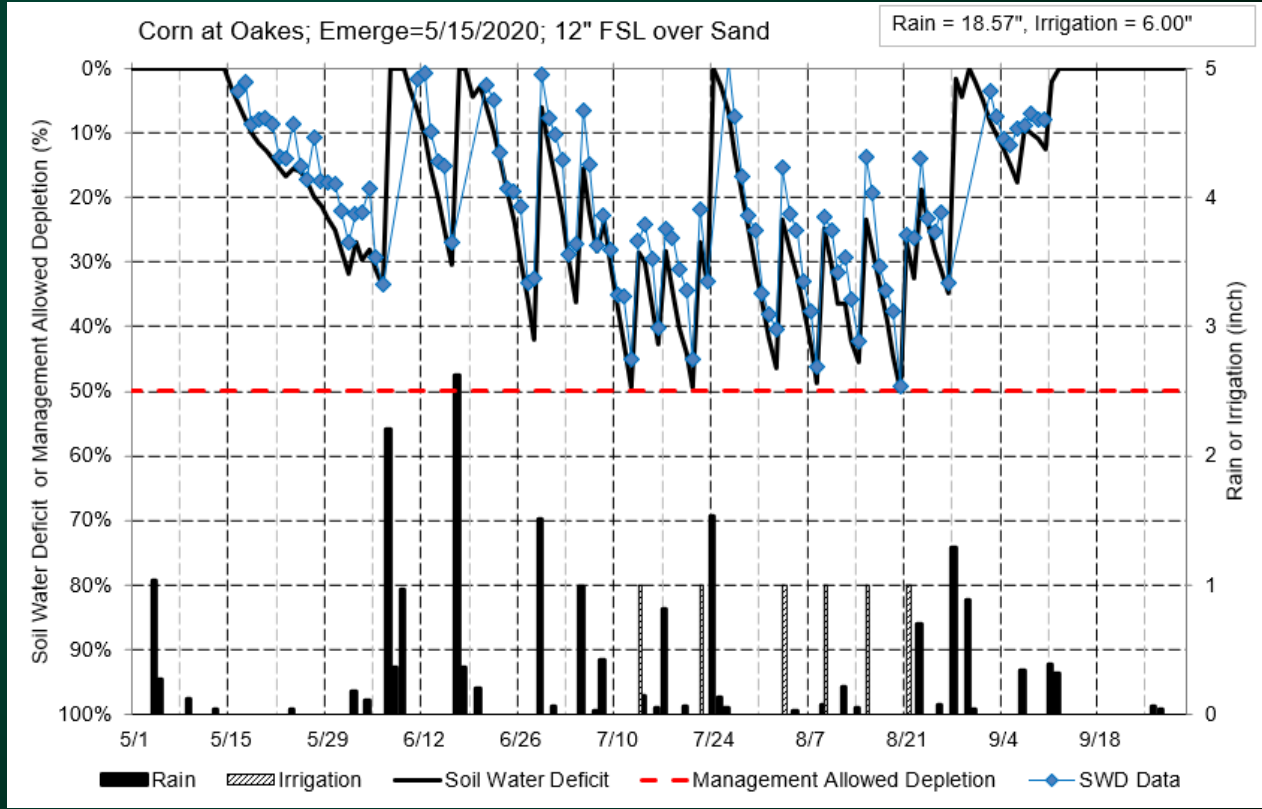
Sensor Performance Comparisons

- Installation
- Data management
- Accuracy



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Prescription Map Comparisons

- How to Use
- Data management
- Comparison to SETMI

- Water volumes

  $V_{diff} = V_x - V_{SETMI}$

- Spatial variability
  - Gravel ridges
  - Low areas

Thank you!

Photo courtesy of Duane Anderson, Leeds, ND

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